December 15, 2012

The focus of today's session was measuring light. Ben did a review of the concepts that they learned about from the last session. He re-drew the figure that showed light coming in, hitting a prism, and then splitting into many different colors, like the rainbow.

He encouraged the kids to look up the vocabulary they learned then – "absorb", "reflect", "cyan", "filter", etc. Diana Jimenez and Emily Espinoza were quite good at this.

Then Levi brought out something new – kind of like a filter but it does something different. He handed out diffraction grating slides to everyone. Everyone started looking through them. One of the boys pointed it toward the sliding glass door, where light was streaming in, and exclaimed, "Oooh!" The kids ran outside to try it.

Next, the WW students passed out lasers pointers. They were instructed, repeatedly, not to point them at anyone's face or eyes. They experimented with one color, then another, then both. They slowly began to notice things, like the way the laser light "split" into a matrix of squares. The kids seemed like they would never get tired of playing with the laser pointers.

With some guidance from the mentors, they began to discover that the distance between the different colors varied. Diana stated, "The green laser goes in the red laser." She was describing the distances between the dots in the matrix. Ben drew a diagram to show how the green dots of light fit within the distance between the red dots. Likewise, the blue dots were closer together than the green ones.

Levi asked them to think about what that meant. "What is light?" When the students were confused about how to answer that, Ben said, "Let me show you something," and drew a wave form on the board. He said we can't see these waves, because they are tiny, but they are a way of drawing something that you can measure.

"What are 'waves'?" Ben asked. "Where do you see waves?" Unexpectedly, no one mentioned the ocean waves nearby. Since they were still stumped about what was being asked, Ben got them thinking about the rainbow.

Are the colors in the rainbow always in the same order? Yes. What is that order? No one was sure. He wrote "ROYGBIV" on the board, and the kids could guess after he said, "Red, Orange, Yellow," that the next color would be Green, then Blue, then …. What??? Indigo, and then Violet. I'm not sure all the kids knew what "violet" was.

So, with the three colors we were playing with, green, blue and red, in the ROYGBIV order, red comes first, and then green, and then blue.

They looked at their gratings again, and began to notice the numbers, and the word "wavelength". Emily and Diana noticed that red had the biggest number, the biggest wavelength. I asked Ben to draw the other colors' waveform, and show the relative sizes. Emily figured out that the distance between the red dots of light seen through the grating was bigger than the green dots, so its wavelength had to be longer.

You know, I'm not sure that's completely logical, but at least it got her thinking about different colors having different measurements. I'm also not sure that they will be able to transfer this understanding to the lower numbers being **more** intense. They might think that red has more intensity than blue because it's "bigger". They need to be shown that the smaller the wave, the higher the number of waves can fit into a … whatever you call it, Space? Beam?... the more intense it is. I would describe that as an inverse relationship, but I bit my tongue.

Next, Ben brought up some weird questions. "Are there colors we cannot see?" Long silence. Naturally, Andres broke it with "Yeah." Itzel offered, "Pink?" Other answers started popping: "White?" "Black?" Samuel knew that white light was made up of all of the other colors. Someone else mentioned that black absorbed all the light. (We did not get into additive or subtractive color, thankfully!)

Somehow, Ben got one answer: "Ultraviolet," from one of the boys. Noah brought up sunburn. Adrian brought up black lights. Paul proceeded to show them some ideas about light or energy that is beyond the spectrum that we see. (I heard Ben mention the "visible light spectrum" but I don't think the kids really got what he was talking about.)

Paul proceeded with his experiment. He got help from Itzel and Diana, who poured "yellow label" water (tonic water) into a flash, and held it over a UV light. It turned … violet. Then, they put "blue label" water (soda water) into a flask, as a control, and showed that it did not glow. Something about a chemical in the tonic water absorbed the light.

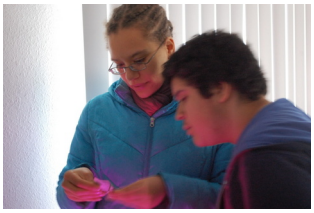
I had to jump in here – because I wanted the kids to think about the term "ultra-violet". What does "ultra" mean? Emily said, "Really big." I agreed – it's "bigger" or "beyond" violet. We can't see it, but it is there; we can see it indirectly with UV lighting or other measurements.

Paul explained how energy can be transferred "up the chain" (my words) – violet can give energy to Indigo, or green can give energy to red, but it doesn't work the other way. It's like Blue is worth $2.00, and Green is worth $1.00, so blue can give $1.00 to Green, but Green can't give its only dollar to Blue or it would be broke. He had Ben and Levi act that out.

Then, he brought out the gooey stuff: gummy bears soaked in tonic water. Everyone got to touch the slimy things, and then see what happened when you shone a UV or purple beam of light on them. The clear/yellowish ones glowed! Very cool.

And yes, you could eat them afterwards!

Sadly, I had to leave at this point, as the grown-ups were looking at $20.00, $50.00 and $100.00 bills under the UV light.



Wow, you're going to give the impression that scientists are not only smart, but they're rich!

Today a different group of mentors from Caltech assembled: Paul Bracher, Anna Beck, Noah Plymale and Amy McCarthy. The other regulars were there: Ben, Kim, Levi, and his 4 near-peer mentors students from Wildwood (WW) School. Several of the children did not come because they are already on a holiday break from school, and many of their families go to Mexico or Central America at this time.